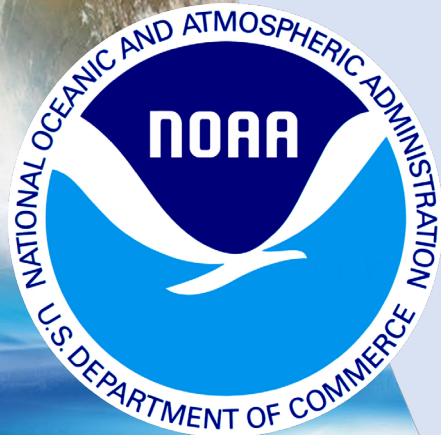




# The SNPP and JPSS Satellite Reprocessing

Status Updates, How to Acquire, Application Examples



C.-Z., Zou, L. Zhou, L. Lin, X. Hao, B. Zhang, K. Ahmad, N. Sun, H. Yang; Y. Chen, T. Beck, B. Yan, and F. Iturbide-Sanchez

**National Environmental  
Satellite, Data, and Information  
Service**

March 17, 2023

NOAA/NESDIS/Center for Satellite Applications and Research (STAR)  
NOAA/NESDIS/Joint Polar Satellite System (JPSS)

# Reprocessing and Benefits

- Single satellite operational calibration algorithms update and improve over time
- Use most recently updated, unified calibration algorithms to generate consistent SDRs for each JPSS/SNPP instrument through their life cycle - Reprocessing efforts are tied closely to the cal val activities: the products are ready for reprocessing when reach validated maturity
- Calibration accuracy for SDRs achieves those from the latest operational calibration algorithms
- [JPSS/SNPP V1 and V2 Reprocessing completed successfully](#), see next slides
- Allow [stability assessment](#) after removal of bias jumps due to operational calibration changes— quantify SDR quality in the time dimension
- [Consistent satellite retrievals](#) allows:
  - Improved environmental data record (EDR) products
  - Building blocks for climate data record (CDR) development
  - Improve climate reanalysis as input datasets
  - Climate trends analyses

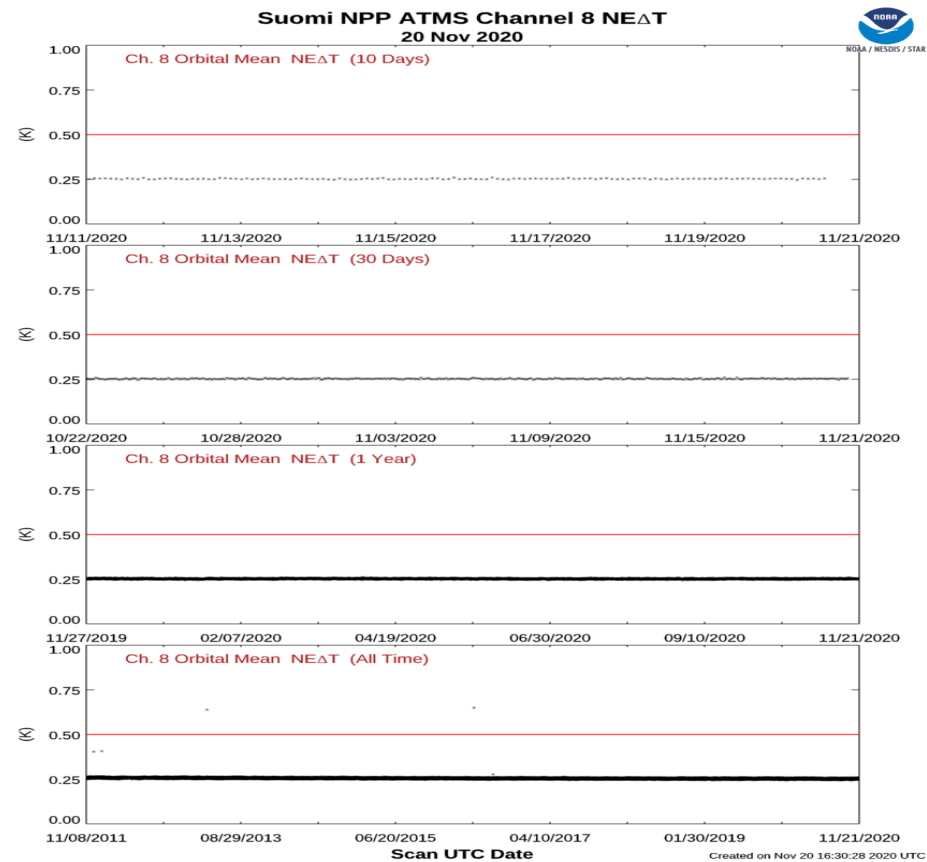


# Status of SNPP SDR Reprocessing

Sensor	Data Type (name)	Period	Notes	Volume (Tb)	Transition to CLASS Status
ATMS	TDR (TATMS)	2011-11-08 to 2019-10-15	V2	0.406	Completed on Dec. 19, 2021
	SDR (SATMS)	2011-11-08 to 2019-10-15	V2	0.431	
	GEO (GATMO)	2011-11-08 to 2019-10-15	V2	0.420	
ATMS	TDR (TATMS)	2011-11-08 to 2017-03-08	V1	0.273	Completed on Dec. 30, 2021
	SDR (SATMS)	2011-11-08 to 2017-03-08	V1	0.289	
	GEO (GATMO)	2011-11-08 to 2017-03-08	V1	0.283	
CrIS	GCRSO	2012-02-20 to 2020-01-29	V2	0.369	Completed on Feb. 25, 2022
	SCRIS	2012-02-20 to 2020-01-29	V2	67.994	
	SCRIF	2014-12-04 to 2020-01-29	V2	74.455	
OMPS	TC (SOMTC, GOTCO)	2012-01-30 to 2018-09-30	V1	1.139	Completed on Mar. 9, 2022
	NP (SOMPS, GONPO)	2012-01-25 to 2017-03-08	V1	0.097	
OMPS	NP (SOMPS, GONPO)	2012-01-25 to 2021-06-30	V2	0.191	Completed on Mar. 9, 2022
	TC (SOMTC, GOTCO)	2012-01-30 to 2021-06-30	V2	1.649	
VIIRS	VIIRS ALL SDR	2012-01-02 to 2020-04-30	V2	1615	to be completed on October 2023
<b>Total</b>	---	---	---	<b>1764.65</b>	

# Assessment of Consistency and Stability of Reprocessed SDRs

- Compare with operational SDRs
- Compare with similar channel observations from other instruments onboard other satellites
- Check ICVS for instruments performance (figure on the right: Absolute stable NEDT performance support the high radiometric stability conclusion )

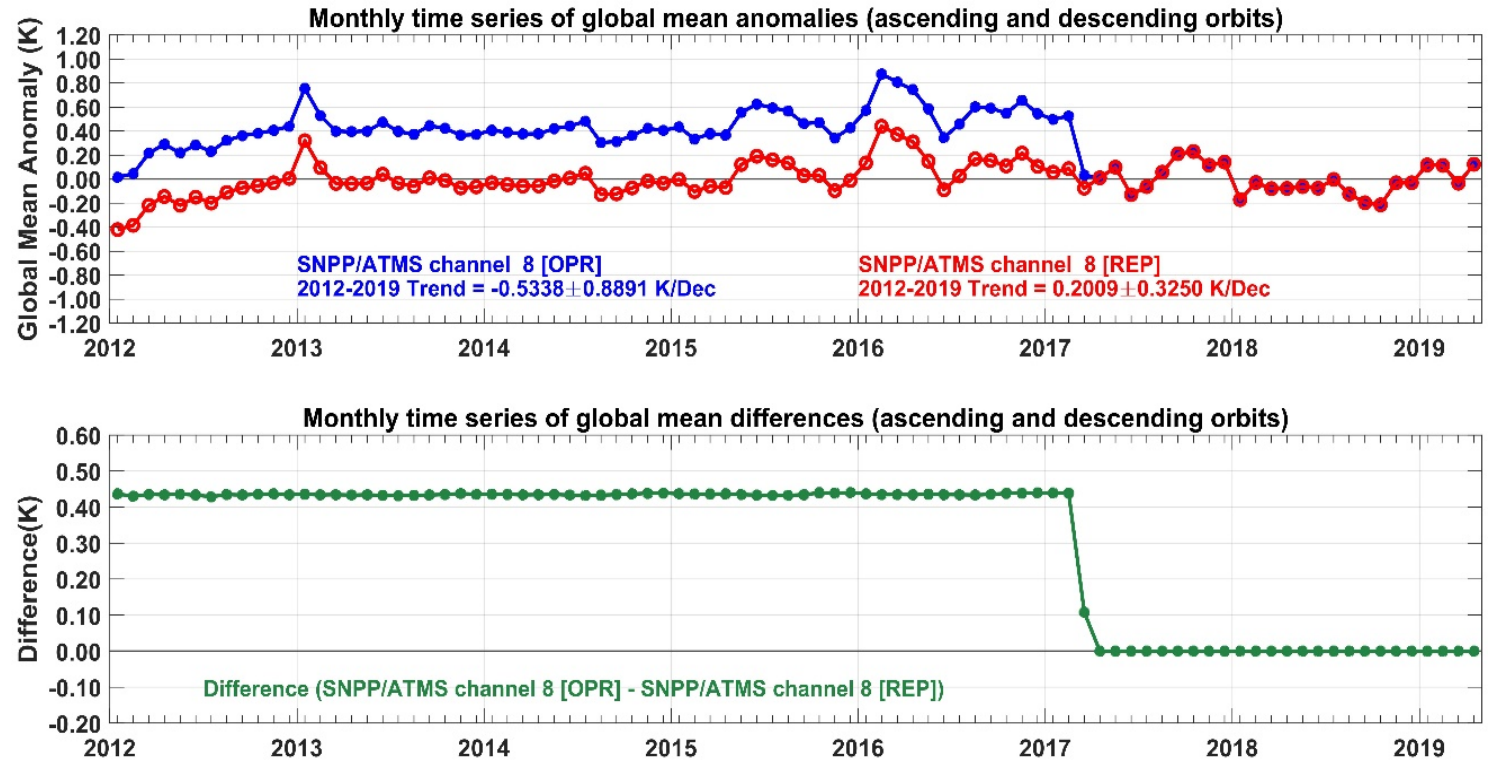


# Compare Operational and Reprocessed SDRs—SNPP/ATMS

\*Changes in operational calibration cause bias jumps

\*The bias jump between the operational calibrated and reprocessed data found in March 2017 was caused by the calibration update for the operational calibration on 8 March 2017

\*After that date, the two datasets are identical since they use the same calibration algorithm

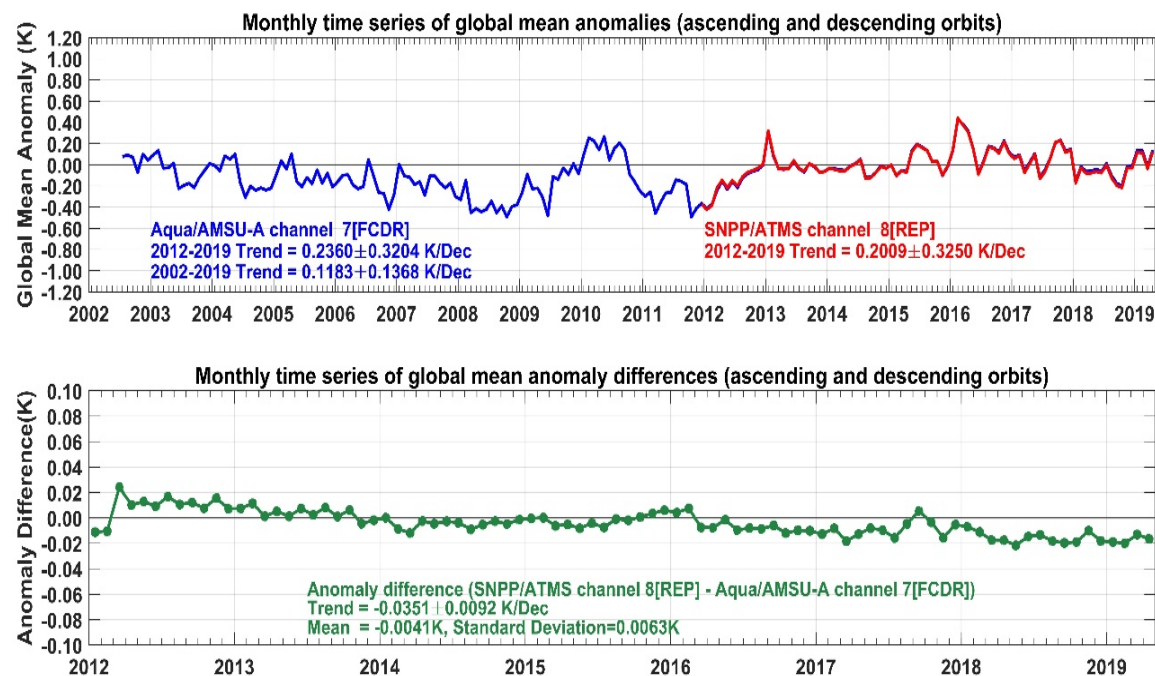


Monthly global mean anomaly  $T_b$  time series for ATMS channel 8 from operational calibrated (blue, top) and reprocessed (red, top) sensor data records and their differences (green, bottom). The global means are calculated using limb-adjusted scan positions from 29 to 68 for both operational calibrated and reprocessed datasets. The limb-adjustment and data processing details can be found in Zou et al. (2018).



# Stability Assessment of Reprocessed SDR—SNPP/ATMS

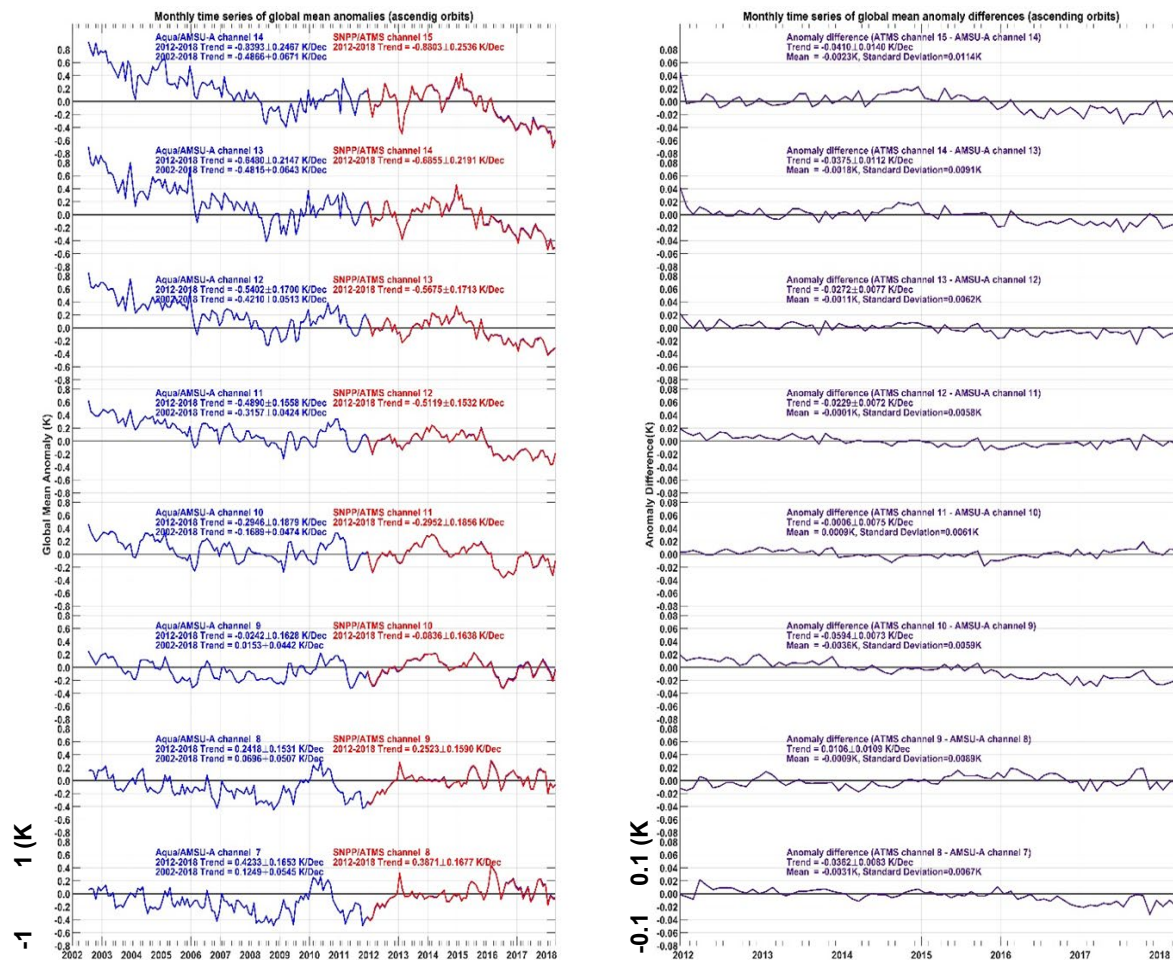
- Reprocessed SNPP/ATMS are compared with Aqua/AMSU-A for their companion channels
- Diurnal sampling difference is absent
  - they are naturally removed by satellites with stable orbits with the same overpass time
- Time series from different satellites match with each other nearly perfectly without applying any diurnal drift corrections or time-dependent inter-calibration
- Calibration drifts could be estimated quite accurately
- Small trend differences suggest high radiometric stability for either instrument



Monthly global mean  $T_b$  anomaly time series for AMSU-A channel 7 onboard Aqua (blue, top) versus ATMS channel 8 onboard SNPP (red, top) and their difference time series (green, bottom). The AMSU-A and ATMS data are from June 2002 and December 2011 to December 2018, respectively. The AMSU-A anomaly time series are overlaid by ATMS during their overlapping period, with their differences shown as nearly a constant zero line in the same temperature scale. Amplified scale of temperature is used in the bottom panel to show detailed features in the anomaly difference time series. Both ATMS and AMSU-A data are from limb-adjusted scan positions of 29-68 and averaged over ascending and descending orbits. Uncertainties in trends represent 95% confidence intervals with autocorrelation adjustments.

# High Radiometric Stability in Aqua, MetOp-A, and SNPP Microwave Sounder Observations

- Time series from Aqua/AMSU-A and SNPP/ATMS match with each other extremely well without applying any time-dependent inter-calibration
- Calibration drifts can be estimated quite accurately
- Small trend differences suggest highly stable observations with either instruments
- Radiometric stability achieved **0.04K/Decade** for most channels for SNPP/ATMS, Aqua/AMSU-A, and MetOp-A/AMSU-A (Zou et al. 2018)



Left: Anomaly time series of Aqua/AMSU-A (blue) and SNPP/ATMS (red); Observation; Right: Their difference time series (plot from Zou et al. 2018)

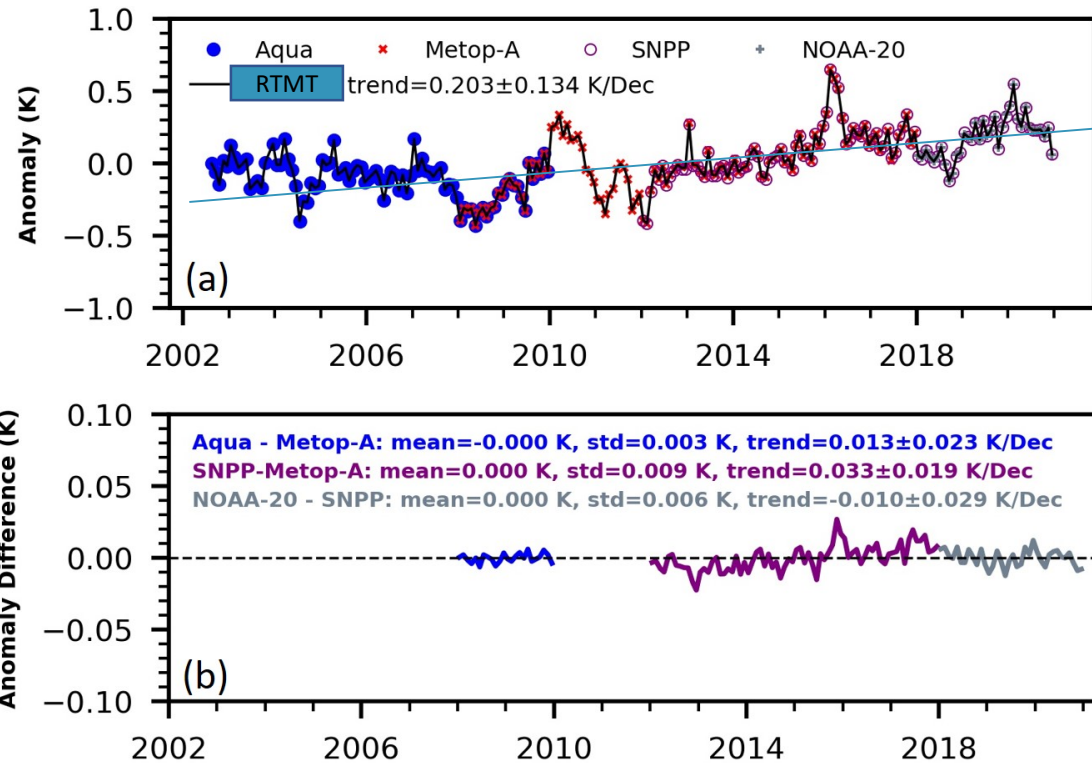
# Reference Temperatures in the Mid-Troposphere (RTMT) Time Series

➤ Maximum relative drift between satellite pairs: 0.033 K/Decade

➤ **RTMT** is an average of available satellite observations which gives a trend of **0.203** K/Decade during 2002-2020

➤ Small sampling theory gives a trend uncertainty =  $\pm \frac{\Delta}{2\sqrt{N}}$   
= **0.01K/Decade**; here  $\Delta=0.033$  K/Decade,  $N=2$  is the overlapping satellite number

➤ Accuracy in trend detection exceeds the required **0.02K/Decade** given in GCOS (2016)



(a) Monthly global mean temperatures in the midtroposphere (TMT) anomaly time series from Aqua, MetOp-A, SNPP, and NOAA20 and the reference TMT (RTMT) time series merged from these satellites; (b) intersatellite difference time series before the merging. Anomalies are relative to a monthly climatology of RTMT for the MetOpA period from January 2008 to December 2017. Uncertainties in trend calculations represent 95% confidence intervals with autocorrelation adjustments (Plots are from Zou et al. 2021).



# User Access to the Reprocessed Data from CLASS

- Two options to get the reprocessed SNPP SDR data from NCEI/CLASS

## A. Tar file FTP download before order interface is available

Data Access Services	<ul style="list-style-type: none"><li>• CLASS FTP</li></ul>
Data Access Locations	CLASS FTP: <ul style="list-style-type: none"><li>• <a href="ftp://ftp-jpss.avl.class.noaa.gov/STAR/">ftp://ftp-jpss.avl.class.noaa.gov/STAR/</a></li></ul>
Data Access Configurations	<ul style="list-style-type: none"><li>• Data directory structure:<ul style="list-style-type: none"><li>• .../&lt;YYYYMMDD&gt;/&lt;Data_Family&gt;/&lt;Data_Type&gt;/&lt;Sat&gt;/&lt;file_name&gt;</li></ul></li><li>• Aggregate native HDF files into ~daily tar files by data type</li><li>• Frequency options:<ul style="list-style-type: none"><li>• “Append with Updates”</li></ul></li><li>• Version configurations:<ul style="list-style-type: none"><li>• “New”</li></ul></li></ul>
Additional Information	Data available for past 85 days.

## B. Archive Tape Search and Order (CLASS search and order interface)— Next page

# CLASS Search and Order Data Interface

NOAA's Comprehensive Large Array-Data Stewardship System (CLASS)

<https://www.avl.class.noaa.gov/saa/products/catSearch>

NOAA COMPREHENSIVE LARGE ARRAY-DATA STEWARDSHIP SYSTEM (CLASS)

CLASS Home | Login | Register | Help | About CLASS | **CLASS** | CLASS Help | All NOAA | SEARCH

Please select a product to search

Search by:  Data Product  Dataset Name  UUID

Search collection metadata:  Submit

**Environmental Data from Polar-orbiting Satellites**  
Polar orbiting satellites collect data on a global scale on a daily basis for use in a variety of land, ocean, and atmospheric applications. Data from the POES series supports a broad range of environmental monitoring applications.

**Environmental Data from Geostationary Satellites**  
The GOES satellites help meteorologists monitor and predict weather events, including tropical storms, tornadoes, flash floods, and other severe weather in the western hemisphere. In addition, GOES satellites monitor dust storms, volcanic eruptions, and forest fires. These stationary satellites can scan the same area of the earth as frequently as every minute.

**Defense Meteorological Satellite Program (DMSP)**  
The DMSP designs, builds, launches, and maintains satellites monitoring the meteorological, oceanographic, and solar-terrestrial physics environments. Equipped with a sophisticated sensor suite that can image visible and infrared cloud cover, the satellites collect specialized meteorological, oceanographic, and solar-geophysical information in all weather conditions.

**Joint Polar Satellite System (JPSS)**  
The JPSS series satellites replaces the legacy POES satellites to provide continuity of critical, global observations of Earth's atmosphere through 2038. Specifically, the JPSS constellation of satellites gather global measurements of atmospheric, terrestrial and oceanic conditions, including air, sea, and land surface temperatures, vegetation, clouds, rainfall, snow and ice cover, fire locations and smoke plumes, water vapor and ozone. CLASS maintains access to a majority of these products since late 2011.

- JPSS Advanced Technology Microwave Sounder Raw Data Record (ATMS\_RDR)
- JPSS ATMS Sensor Data Record Reprocessed (RPATMSSDR)**
- JPSS ATMS Temperature Data Record Reprocessed (RPATMSTR)**
- JPSS Auxiliary Files (NP\_AUX)
- JPSS Cal/Val Investigator Containers (NPCONTRIP)
- JPSS Clouds and Earth Radiant Energy System Raw Data Record (CERES\_RDR)
- JPSS Cross-track Infrared Sounder Intermediate Product (CrIS\_IP)
- JPSS Cross-track Infrared Sounder Raw Data Record (CrIS\_RDR)
- JPSS CrIS Sensor Data Record Operational (CrIS\_SDR)
- JPSS Cross-track Infrared Sounder with the Advanced Technology Microwave Sounder IP (CRIMSS\_IP)
- JPSS Cross-track Infrared Sounder with the Advanced Technology Microwave Sounder IP (NP\_DOC)
- JPSS Mission Notices (NP\_MSNNTC)
- JPSS Official Dynamic Ancillary Data (NP\_ODAD)
- JPSS Software Release Pkg (NP\_SW)
- JPSS Spacecraft (NP\_SPCRFRT)
- JPSS Supporting Data Release Pkg (NP\_SD)
- JPSS Test Data Release Pkg (NP\_TD)
- JPSS Ozone Mapping and Profiler Suite Environmental Data Record (OMPS\_EDR)
- JPSS Ozone Mapping and Profiler Suite Intermediate Product (OMPS\_IP)
- JPSS Ozone Mapping and Profiler Suite Raw Data Record (OMPS\_RDR)
- JPSS Visible Infrared Imaging Radiometer Suite Environmental Data Record (VIIRS\_EDR)
- JPSS Visible Infrared Imaging Radiometer Suite Imagery Band Environmental Data Record (VIIRS\_IBEDR)
- JPSS Visible Infrared Imaging Radiometer Suite Intermediate Product (VIIRS\_IPGD) Gridded
- JPSS VIIRS Intermediate Product Operational (VIIRS\_IPNG) Non-Gridded
- JPSS VIIRS Intermediate Product Reprocessed (RPVIIRSNG) Non-Gridded**
- JPSS VIIRS Sensor Data Record Operational (VIIRS\_SDR)
- JPSS VIIRS Products (Non-Gridded) (JPSS\_NGRN)
- JPSS Sounder Products (JPSS\_SND)
- Microwave Sounder-based Tropical Cyclone Products (MW\_TC)
- River and Surface Flood Map Products (RSVFM)

## JPSS ATMS Sensor Data Record Reprocessed (RPATMSSDR)

NOAA's Comprehensive Large Array-Data Stewardship System (CLASS)

<https://www.avl.class.noaa.gov/saa/products/catSearch>

NOAA COMPREHENSIVE LARGE ARRAY-DATA STEWARDSHIP SYSTEM (CLASS)

CLASS Home | Login | Register | Help | About CLASS | **CLASS** | CLASS Help | All NOAA | SEARCH

JPSS ATMS Sensor Data Record Reprocessed (RPATMSSDR)

Search - RPATMSSDR

**Data Description**  
ATMS Reprocessed SDR (Product RPTMSSDR) - The Advanced Technology Microwave Sounder (ATMS) is a cross-track scanner measuring atmospheric temperature and moisture observations for weather and climate applications. Level-2 Sensor Data Records (SDR) from ATMS are the calibrated and geolocated radiance and reflectance data produced from ATMS Raw Data Records. The data family includes reprocessed ATMS science SDRs and geolocation SDRs from Science NPV. The reprocessing generated consistent Level-2 SDRs using unified and consistent calibration algorithms that removed artificial jumps in data caused by operational change, instrument anomalies, contamination from secondary scans of the atmosphere or aerosols, and other causes. The reprocessed SDRs were compared with and validated against other observations whenever such data were available. This data family includes two reprocessed data versions (R17 and R18). ATMS SDRs are used to produce atmospheric sounding Environmental Data Records (EDR). ATMS SDR data obtained from the NOAA Comprehensive Large Array-Data Stewardship System (CLASS) are distributed as aggregated R records (see consistency of T3 granules in the International Data Format v3 (IDF) to soft metadata attributes included. See the "Details - Metadata, Documentation" section below for additional information. Collection landing pages for the products included in the family can be accessed via the "Product Details" link.

**Details - Metadata, Documentation**

**Notes**

- 01/31/2022 - To access the more recent data please go to the ATMS\_SDR products search page. The operational data (prod 01/31/2021) use the latest version of the reprocessing algorithm.
- 01/31/2022 - The Reprocessed ATMS data is now available to the public, starting on 01/31/2022.
- 08/31/2021 - For a detailed description of the reprocessing users are directed to the following paper: Liu et al., 2020, The Reprocessed Suomi NPP Satellite Observations, Remote Sens. 2020, 12, 2891. <https://doi.org/10.3390/rs12182891>.

**Spatial**

**Temporal**

(Maximum range is 365 days)

Start Date (Format: YYYY-MM-DD)   Start Time (UTC) (Format: HH:MM:SS)

End Date (Format: YYYY-MM-DD)   End Time (UTC) (Format: HH:MM:SS)

Specify the range of the time for:  Each Day  The Entire Range Of Days

**Advanced Search**

Dataset:  Sensor Data Record  Ancillary  Geolocation  Other

Selection:  ATMS SDR (QA/AS)  ATMS SDR (Unrep) Geolocation (GATMS)

Dataset:

Dataset Series:  Reprocessed Version 1 (2011-1-1-09 - 2017-4-30-09)  Reprocessed Version 2 (2011-1-1-09 - 2016-06-09)

**The Reprocessed SPP ATMS data is available now!**



# Documentation

## Selected Publications

- Zou, C.-Z., Zhou, L., Lin, L., Sun, N., Chen, Y., Flynn, L. E., Zhang, B., Cao, C., Iturbide-Sanchez, F., Beck, T., Yan, B., Kalluri, S., Bai, Y., Blonski, S., Choi, T., Divakarla, M., Gu, Y., Hao, X., Li, W., Liang, D., Niu, J., Shao, X., Strow, L., Tobin, D. C., Tremblay, D., Uprety, S., Wang, W., Xu, H., Yang, H., & Goldberg, M. D. (2020). The Reprocessed Suomi NPP Satellite Observations. *Remote Sensing*, 12(18). [\[10.3390/rs12182891\]](https://doi.org/10.3390/rs12182891)
- Chen, Y., Iturbide-Sanchez, F., Tremblay, D., Tobin, D., Strow, L., Wang, L., Mooney, D. L., Johnson, D., Predina, J., Suwinski, L., Revercomb, H. E., Sun, N., Zhang, B., Cao, C. Y., Kalluri, S., & Zhou, L. H. (2021). Reprocessing of Suomi NPP CrIS Sensor Data Records to Improve the Radiometric and Spectral Long-Term Accuracy and Stability. *IEEE Transactions on Geoscience and Remote Sensing*, 60, 1-14. [\[10.1109/TGRS.2021.3060639\]](https://doi.org/10.1109/TGRS.2021.3060639)
- Uprety, S., Cao, C., Gu, Y., Shao, X., Blonski, S., & Zhang, B. (2019). Calibration Improvements in S-NPP VIIRS DNB Sensor Data Record Using Version 2 Reprocessing. *IEEE Transactions on Geoscience and Remote Sensing*, 57(12), 9602-9611. [\[10.1109/TGRS.2019.2927942\]](https://doi.org/10.1109/TGRS.2019.2927942)
- Cao C, Zhang B, Shao X, Wang W, Uprety S, Choi T, Blonski S, Gu Y, Bai Y, Lin L, Kalluri S.(2021). Mission-Long Recalibrated Science Quality Suomi NPP VIIRS Radiometric Dataset Using Advanced Algorithms for Time Series Studies. *Remote Sensing*. 13(6):1075.
- Yan, B., C. Pan, T. Beck, X. Jin L. Wang, D. Liang, L. Flynn, J. Chen, J. Huang, S. Buckner, C.-Z. Zou, N. Sun, L. Lin, A. Yong, L. Zou, and W. Hao, 2022: Life-Time Quality-Consistent Suomi NPP OMPS Nadir Sensor Data Records: Calibration Improvements and Performance Assessment of Reprocessed Data Sets. *Remote Sens.*, 14(13), 3125; <https://doi.org/10.3390/rs14133125>.



# Backup

